

FINAL TECHNICAL REPORT
PROPOSAL FOR FISCAL YEAR 2006

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Title:

12th Advanced Accelerator Concept Workshop

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**Summary of the 12th Advanced Accelerator Concept (AAC 2006)
Workshop held by NIU and ANL on July 10th-15th 2006 in Lake Geneva
WI (OSP # 06025)**

The Twelfth Workshop on Advanced Accelerator Concepts was held at the Grand Geneva Resort in Lake Geneva, Wisconsin, from July 10 to July 15, 2006. The Workshop was sponsored by the High Energy Physics program of the U.S. Department of Energy, and was hosted by the Argonne Wakefield Accelerator Group (AWA) of Argonne National Laboratory and by Northern Illinois University. The workshop is a bi-annual meeting among physicist working on novel charged particle acceleration concept. The name “advanced accelerator” physics covers long term research and development in beam physics and accelerator technologies. Some of the topics in advanced accelerator R&D are laser acceleration of electrons, wake field acceleration, novel high power rf source, new beam diagnostics, free-electron lasers, generating high brightness electron beams etc. The Advanced Accelerator Concept workshop is the only acknowledged and fully sponsored forum that provides a platform for inter- and cross-disciplinary discussion on various aspects of advanced accelerator and beam physics/technology concepts.

Among the 186 invited workshop attendees were a record number of 51 students, illustrating the vitality of the field. Since its inception in the early 1980s, the primary purpose of this series of workshops has been the exchange and debate of ideas, along with the presentation of new achievements, in the area of advanced accelerator science and technology. This encompasses experimental, theoretical, and computational investigations dealing with a multitude of physical systems: accelerating structures, plasmas, lasers, RF power, beam sources, diagnostics, etc. Comparing the work reported in these proceedings with the reports from the earlier workshops, one can clearly appreciate the steady growth and maturation of the field. Some of the concepts and techniques are now significantly better understood and explored. Yet, new ideas continue to be brought up and investigated, demonstrating the growth and vitality of the field. The Workshop opened with a full day of plenary talks, followed by four days of plenary talks in the early mornings and Working Group presentations and discussions in the late mornings and the afternoons. Seven Working Groups were formed and workshop participants divided themselves among these groups. The working groups were:

1. Computational Accelerator Physics,
2. High-Gradient Structures,
3. High Energy Density Physics and Exotic Acceleration Schemes
4. e-Beam Driven Accelerators,
5. Beam Generation, Monitoring, and Control,
6. Laser Plasma Acceleration,
7. EM Structure Based Accelerators.

Obviously, there was significant overlap among the topics covered by the various groups, and some participants chose to attend sessions in several Working Groups. Also working group leaders sometime organized joint session between two working group dealing with issues of similar interest for two working group (for instance the discussion of ultrashort diagnostics for electron beam is of interest for laser acceleration (where bunches are inherently short) and beam diagnostics working group. There was also one poster session, primarily to allow for presentations that, for lack of time, could not be delivered orally during the Working Group sessions. The last morning of the Workshop was occupied by summaries given by the Working Group leaders, who briefly described the presentations and discussions that had taken place in each group.

On the technical side, the workshop, this year, was marked by a tremendous progress done in the field of plasma wakefield acceleration several group from US, England and China presented groundbreaking results and experimentally demonstrated the production of electron beam and its acceleration to GeV's energy within few centimeters using laser-plasma interaction. Similarly a group from SLAC demonstrated the energy doubling of SLC using a plasma wakefield accelerator the beam with incoming energy of 40 GeV (out of a several kilometer accelerators) was boosted to about 80 GeV over ~1 m plasma wakefield accelerating structure. These results pave the road for very compact (table-top) multi-GeV electron accelerators. Finally a novel acceleration mechanism predicted a decade ago was experimentally demonstrated at Brookhaven Accelerator Test Facility: the PASER, or particle acceleration via stimulated emission of radiation, is in essence the inverse process of the LASER.

Participants were invited to write papers that were published in the American Institute of Physics Conference Proceedings series under the title "12th Advanced Accelerator Concepts Workshop" volume **877**. This impressive report contains 120 invited and contributed papers!

In summary AAC 2006 was a fruitful and exciting workshop. Advanced accelerator physics is a rapidly developing field with great promises ahead. The workshop organization was excellent thanks to ANL and NIU administrative staffs.